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ELISHA MITCHELL SCIENTIFIC SOCIETY.

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"PHYSIOLOGICAL ECONOMY IN NUTRITION"—*Chittenden.*

DR. ISAAC H. MANNING.

There cannot be a more generally interesting subject than Physiological Economy in Nutrition. The habit of excessive indulgence at the table is still very common and habitual over-eating is practically universal. The pernicious effects of the former are often immediate and convincing, while the harmful effects of the latter, though insidious, are none the less certain. The restraint of one's appetite, after generations of hereditary and years of acquired indulgence, and its restriction to a diet nearly approaching the actual needs of the body, requires a degree of self control and watchfulness that few of us possess, and yet it needs no argument to convince us that every ounce in excess of this entails a wasteful expenditure of body energy, an unnecessary and harmful burden on the body machinery, and places both our mental and physical effectiveness on a lower plane. The mental and physical hebetude following a heavy meal is a common experience and so often has disease been traceable to disturbances

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in nutrition that it is a medical axiom that the "majority of diseases of mankind are due to or are connected with perversions of nutrition." The habit of undereating is none the less pernicious, but, if we are to accept Dr. Chittenden's standards, it is so rare as to demand little consideration.

A diet just sufficient to maintain the highest mental and physical effectiveness, with due consideration for a capricious, somewhat fanciful appetite is the ideal. An effort to establish such a dietetic minimum, of more or less general application, through experiment, has resulted in the formulation of dietetic standards by Voit, Ranke, Hoppe-Seyler, and others, all agreeing in the main that the average adult doing an ordinary amount of work requires something more than 100 grams (3 to 4 oz.) Proteids (the chief constituent of meat), 250 grams (9–10 oz.) Carbohydrates (the chief constituents of cereals), and 100 grams (3–4 oz.) fat; which, together, should have a heat value of about 3,000 heat units (the large calorie). On such a diet it has been found that the individual could maintain a nutritive balance, neither gaining nor losing in weight. These standards have been generally adopted and an analysis of the average diet of soldiers and laborers of different nationalities, as well as other groups of men, have shown them to be rather more than less. But from time to time individual experience and experiment have suggested that they were too high and should be subjected to a critical review and revision. With this object in view, Dr. Chittenden, of Yale University, began his investigation, the results of which have been published in book form under the well chosen title of Physiological Economy in Nutrition (Stokes & Co., New York).

Among the striking features of the book is the prominence given the proteid constituents of our diets and his conclusions will be disappointing to the average American who is proverbially a heavy meat-eater and to the athlete who often thinks his success depends upon the number of pounds of meat he can consume. The proteids have been recognized as

the basic constituents of all bioplasm (living substance) and for its repair and growth they must form the most important, though not necessarily the most abundant constituent of our diets, for it has been demonstrated over and over again that one cannot maintain a healthy condition without proteids in one form or another. This has been perhaps the strongest argument with the trainer who wishes to encourage the growth of muscles, notwithstanding the easily proved fact that muscular exercise does not increase the use of proteid matter. Dr. Chittenden calls attention to the fact that an excessive proteid diet produces more strain than any other. They are difficult to digest, difficult to assimilate, and the waste is difficult to eliminate, taxing especially the liver and kidneys. Then again, among the innumerable products of proteid digestion, there are formed many more or less poisonous compounds which act deleteriously on the nervous, muscular, and circulatory systems. Hence an excess of proteids is especially to be avoided. The fat and carbohydrates—especially the latter—are ultimately oxidized to CO_2 and H_2O, and the elimination of the excess does not entail so a great hardship. This, however, does not warrant an excessive indulgence.

An ideal diet, then, should contain just sufficient proteid to make good the wear and tear of the body machinery and to provide for a legitimate growth and, in addition, sufficient carbohydrate (especially) and fat to furnish the body energy; a little meat and the rest vegetable matter. The chief object of the research is to determine the minimum amount of proteid necessary to maintain a proteid balance, with an adequate amount of fats and carbohydrates, for it has been shown that, in the absence of the latter, the proteids will be utilized directly for the production of body energy—a misappropriation—and the proteid diet correspondingly high.

The index to the amount of proteid digested in the body is the amount of nitrogen excreted in the urine during a corresponding period of time. To this is added the amount

of undigested nitrogen and the sum should be equal to the total nitrogen taken in with the food. Where such is the case the individual is said to be in nitrogen balance—the intake is equal to the outgo. If, however, the income is less than the outgo, the individual is accumulating nitrogen as proteid or its by-products. In neither case is one in nitrogen balance. It must be remembered, however, that there may be a nitrogen balance on an excessive proteid diet—so elastic is the assimilating and eliminating power of the body. But it would seem that on a minimum proteid diet this method would give us control of the process.

Different individuals—differing in size, weight, habits, and occupation—require a slightly different amount of proteid, and in order to eliminate this personal equation as far as possible and to make the dietetic standard of general application, it was necessary to experiment upon a number of individuals. In this investigation there was a liberal choice. Among those experimented upon we find professional men, teachers, students, athletes, and soldiers (a squad being detailed from the U. S. Army Hospital corps)—representing a variety of individuals engaged more or less actively in mental and physical exercises.

In previous nutrition experiments the period of time covered by the experiment has been too short to warrant safe conclusions. In these, however, the individuals were under experimental observation for periods of six and nine months, which would seem amply sufficient to determine whether the individual can be maintained indefinitely in nutritive balance with full mental and physical vigor on a given diet. In this respect the investigation is superior to those previously reported and warrants a greater degree of confidence in the conclusions.

The plan of the investigation was exceedingly well thought out and faithfully executed. For two weeks previous to the curtailing of the diet, and while the individual was still living on his accustomed diet, daily determinations of the total

nitrogen excreted in the urine were made and its equivalent in proteid recorded. Then there was a gradual withdrawal of the diet—especially the proteid constituents—thus allowing the body to adjust and adapt itself to the change; and this was continued until a nutritive balance (as indicated by a constant body weight and confirmed by balance experiments) was reached. The balance experiments were performed at stated intervals and covered periods of seven days, during which the food was accurately weighed, samples drawn and analyzed, and daily determinations of the nitrogen in the excreta were made and a balance sheet drawn. During the investigation each individual was furnished with a liberal diet list—the composition of the different ingredients being furnished—from which he might select such articles as would gratify his taste, bearing in mind only the general purpose of the experiment. The advantage of this is obvious when we remember that however choice a diet list may be, if it is restricted in variety, it will become distasteful. Systematic records were kept of the body weight, muscular power, and mental vigor, as is customary in gymnasiums and psychological laboratories, to which was added the testimony of the individual as to his general health, physical and mental condition. In some cases periodical blood examinations were made to detect, if possible, any change in its character in consequence of the restricted diet and the results recorded.

The enormous amount of work entailed by such an investigation can only be appreciated by a careful examination of the innumerable tables which contain the results of the quantitative analyses of foods and excretions, blood tests, physical tests, etc., which were systematically made throughout the entire period on each individual. The energy, patience, and perseverance displayed excites one's admiration.

The investigation seems to demonstrate conclusively that Voit's and all previously formulated standards are much too high, especially as regards their proteid constituents. These can be safely reduced 50 or 60 per cent., provided there is an

adequate amount of fats or carbohydrates. The further conclusion seems warranted that it is seldom necessary to increase the heat value of the food beyond 3,000 large calories and in most instances it may be less. This reduction in the diet does not bring us to vegetarianism nor abstinence from meats, but merely to temperance. Nor does it mean the slightest loss in physical or mental vigor or endurance. On the contrary, the records indicate an increase in muscular power and endurance and so far as mental vigor may be tested or judged, this was unimpaired. The improvement in the general health in Dr. Chittenden himself during the nine months in which he was on a restricted diet and among those who independently adopted a similar regime amply justifies the assertion that dietetic temperance conduces not only to one's general health, but must contribute to longevity of life. Nor does it entail any discomfort arising from an unsatisfied appetite after one has become adapted and adjusted to the restriction, and this may, in a measure, be controlled by prolonged chewing of the food, which is a good habit under any circumstances. It may prove interesting to outline Dr. Chittenden's record of himself during the period of experiment, which is not the least interesting one. Previous to the experiment he was living on a diet corresponding approximately to Voit's standard and was eating sufficient proteids to pass about 16 grams N. in his urine per diem. At this time he was 47 years old and weighed about 167 pounds. He gradually reduced his diet until he was passing on an average of only 5.669 grams N. in 24 hours; corresponding to 35.6 grams Proteids—about one-third the amount prescribed by Voit. And while the heat value of his diet fluctuated to some extent, it seldom exceeded 2,000 large calories and was generally below it. In the early weeks he lost slightly in weight reaching 160 pounds, and it then remained constant throughout the experiment. For a time he would eat no breakfast, a light lunch at 1:30 and a heavier dinner at six. This degree of temperance could be reached only after a gradual reduction, but he states that even now

he has no desire to return to his former habits. He succeeded in reducing the Nitrogen in his urine to a greater extent than any one else, but this was probably due to a greater self control, born of his enthusiasm for the investigation. It is interesting to note that Folin in reporting the analysis of the urine of a vegetarian in apparently perfect health as containing a little less than 5 grams Nitrogen, remarks that "no one would be willing to call it normal urine" (the usual interpretation put upon such urine would be an insufficient action of the kidneys).

It is interesting to contrast Dr. Chittenden's record with Stapleton's, a professional athlete and wrestler, who is described as a man of great muscular development and power. At the beginning of the experiment he weighed about 195 pounds, and on his customary diet was excreting an average of 19.7 grams Nitrogen, corresponding to 123 grams metabolized proteids. (Unfortunately the heat value of the diet is not stated, but it was probably large). He succeeded in reducing the Nitrogen excretion to 9 grams in the 24 hours, corresponding to about 57 grams proteids—a reduction of more than one-half—and this on a diet that rarely exceeded 3,000 heat units. In the early weeks, as before, there was a slight reduction in weight until he reached 185 pounds and this remained fairly constant; his total muscular power increased 25 per cent. during the six months, and this, it may be stated, was not due to a change in the character or the amount of exercise. Similar results were recorded of other athletes and the soldiers who were given more or less vigorous gymnasium exercise, and it may be well to call attention again to the conclusion that a heavy meat diet for athletes is unnecessary and irrational.

The results of this classical investigation are of such far reaching importance that they should not only interest the physician, but every one who takes himself seriously and wishes to bring himself to the highest plane of physical and mental effectiveness. The book is thoroughly readable and comprehensible to the average reader.

CORUNDUM AND THE PERIDOTITES OF WESTERN NORTH CAROLINA. A REVIEW.

JOSEPH HYDE PRATT AND JOSEPH VOLNEY LEWIS.

Under the above title, Volume I of the North Carolina Geological Survey reports has recently appeared. The scope of the work, however, is broader in many ways than this title indicates. It is a volumes of 464 pages and is illustrated by 45 plates and 35 figures in the text. While the report is the result of collaboration, the work has been divided so that, in the main, the mineralogical investigations have been conducted by Dr. Pratt and the petrographical study of associated rocks has been the work of Professor Lewis. The preface states: "To only a limited extent have the authors been able to carry on field work together. The work for the most part has been done at different times, each working independently. Notwithstanding this fact and the somewhat different methods employed, each has been led to essentially the same conclusions in the interpretation of field observations. Especially is this true in regard to the theories of the origin and present relations of both the peridotites and the corundum.

A brief sketch of Geology of the State is given in Chapter I, with a somewhat fuller description of the belt of gneiss, granites and schists, constituting the mountain section of the west, and in which the peridotites and the corundum deposits of the State occur.

Chapter II deals with the peridotites and associated basic magnesian rocks, including four varieties of peridotites, four pyroxenites, four gabbroic rocks, an amphibolite, and three varieties of diorite. These are chiefly well known types, with the exception of the pyroxenite composed of the orthorhombic

pyroxene, enstatite. This rock is somewhat commonly found throughout the region and forms many masses of considerable extent. The name *enstatolite* is proposed for this type, in conformity with the terms bronzitite and hypersthenite. These rocks are discussed in their relations to the belt of similar rocks which extends the whole length of the eastern crystalline belt, from central Alabama through Georgia, South Carolina, North Carolina, Virginia, Maryland, Delaware, Pennsylvania, New Jersey, New York, the New England States, Quebec, and Newfoundland.

Maps are given showing the distribution and relations of these rocks to the crystalline rocks in eastern North America and western North Carolina, besides several detailed maps of various portions of the belt of particular interest. The contoured map of western North Carolina is on scale of eight miles to the inch, with the base printed in three colors, after the manner of the maps of the United States Geological Survey. On this the "Conglomerates, quartzites, slates, etc., chiefly 'Ocoee,' correlated with Cambrian by the U. S. Geological Survey," and the "Gneisses, schists, granites, diorites, and other crystalline rocks of pre-Cambian age," are clearly represented by tints, while the numerous dikes of peridotites and related rocks and the occurences of corundum, chromite and asbestos, are shown in bright red.

The petrographic descriptions which constitute Chapter III are illustrated by half-tone reproductions of photomicrographs, showing the mineralogic and structural variations and modes of alteration of the rocks described. Following the general descriptions of these rocks throughout the Appalachian region, the distribution and petrographic characters are given in considerable detail for western North Carolina.

In addition to the numerous facies of primary rocks, secondary types are also described, including those mechanically derived from the primary types, now represented by gneisses, schists and gabbro-diorite, and also a series of hydrous alter-

ation products, including serpentine, steatite, and chloritite (chlorite-rock). The vast majority of occurrences of these basic rocks, while showing more or less alteration, are essentially fresh primary types, especially the pure olivine-rock dunite, which is much the most common. Steatite is pretty widely distributed as an alteration product, but massive serpentine is almost entirely confined to an area extending about 15 miles north and south of the French Broad river. Even in these cases, however, the origin of the serpentine from peridotites of exactly similar character to those found in adjoining regions is very evident.

Chapter IV takes up the modes of alteration and decomposition of the peridotites, and five distinct processes are recognized: 1. Weathering; 2. Serpentinization; 3. Steatitization; 4. Chlorotitization; 5. Amphibolization. The processes of weathering and sepentinization are wellnigh universal, though developed only to a slight extent except in a few localities. Alteration to talc, chlorite and amphibole are much more limited in their manifestations, but have given rise to many important rock masses. The various processes as affecting the peridotites of diverse composition are described minutely.

The long vexed question of the origin of peridotites is taken up in Chapter V. The strong trend of modern thought toward the theory of igneous origin is clearly brought out, and the correctness of this theory is abundantly substantiated by observations in North Carolina. The data presented upon this point are arranged under five heads: 1. Mineralogic characters; 2. Microscopic characters; 3. Gross structures; 4. Modes of occurrence; 5. Relations to the gneisses and schists. This is followed by a discussion of the general petrology of the peridotites and associated rocks in which the conception of genetic unity of the whole series is strongly emphasized.

It is pointed out as a noteworthy fact that many of these rock types are closely associated in almost every occurrence

throughout the crystalline belt of eastern North America. Usually one or another type preponderates in any particular region, but the associations are always essentially the same. Thus the peridotites, particularly dunite, prevail in North Carolina and Quebec, the pyroxenites in Pennsylvania, and the gabbros are very abundant in Delaware and Maryland. In fact the types represented in the various regions are almost identical, and the petrology is closely similar, except in relative abundance of the various types, and in degree of alteration.

In discussing the magnetic relations of the peridotites, anorthosites, amphibolites, etc., two generations of corundum are recognized. The greater part, including all deposits of commercial value, belongs to the first generation, and was formed by the crystallization of the excess of alumni in the original peridotite magma. A very small part, however, occurring in microscopic grains, has been produced by an excess of alumina arising from the corrosion of anorthite by the still molten magnesia magma. This process has produced the sheaths of intermediate minerals which form the *corrosion mantles*, so beautifully developed in some localities, or which, in some cases, entirely replace the anorthite or the olivine, as the case may be, with nest-like aggregates.

Regarding the age of the peridotites, the conclusion of the present writers may be summarized as follows: Sufficient data are not yet available for a satisfactory determination of the age of these rocks, but their intrusion was probably contemporaneous, or practically so, for the whole region from Newfoundland to Alabama. The peridotite belt lies in a region of great disturbance and intense metamorphism. This fact, together with the geological relations to the northward, suggests the hypothesis that the principal period of intrusion was closely associated with the orogenic movements which closed the Lower Silurian (Ordovician) period. The distribution of these rocks may well mark to a great extent the axis

of most intent folding and faulting. The latter Appalachian disturbances, at the close of the Carboniferous, have produced the laminationso often seen in these rocks, and have probably given occasion for later minor intrusions. This hypothesis is not offered as a final answer to the question of age of the peridotites. Much painstaking work yet remains to be done before an entirely satisfactory solution of this problem can be expected.

The chapter closes with a discussion of the relations of the secondary rocks, in which the attempt is made to trace the various laminated and hydrated alteration products back to their original types. Here the question is reaahed, whether the amphibolites, diorites, hornblende-schists and hornblende gneisses may not themselves have been derived from corresponding pyroxenite types, such as are met with in the Maryland and Delaware gabbro areas. The fact is pointed out that undoubted gabbro-diorites do exist in portions of the belt in North Carolina, and hence it is considered probable that many, if not all of these rocks, as well as similar rocks throughout the region, have had a like origin.

After a discussion of the physical and chemical properties of corundum in Chapter VI, is given a description of the various applications of the mineral in the arts, and an outline of the process of manufacture of the several types of corundum and emory wheels on the market.

Chapter VII deals with the modes of occurrence of corundum. In North Carolina the mineral is known in five types of igneous rock; namely, peridotite, pyroxenite, amphibolite, anorthosite, and pegmatite, in six metamorphic rocks, serpentine, gneiss, mica-schist, amphibole-schist, and chlorite-schist. It is also found in gravel deposits of emery whose relations are undetermined. These modes of occurrence are described in detail, and are compared with similar occurrences, when known, in other parts of the world. The deposits which have been of chief commercial importance in North

Carolina have been associated with peridotites, and to a less extent with pyroxenites and amphibolites. The gravel deposits are of considerable interest on account of the corundum gems (ruby) and associated garnet gems (rhodolite) that have been found in some of them.

With the peridotites the corundum occurs chiefly in "peripheral or border veins" striking along the borders of many of the massive outcrops, and in "interior veins" extending from the borders at greater or less distances toward the center of the peridotite masses. In the pyroxenite and certain of the amphibolite occurrences the mode is similar. In other amphibolites the corundum is irregularly distributed in grains and larger plates and nodules through portions of the rock. Certain small pegmatite dikes accompanying and penetrating both the peridotite and amphibolite, are found also to carry corundum. The corundum-bearing serpentine, amphibolites, and chlorite-schists are simply alterations of some of the foregoing types, with more or less dynamic disturbances and re-arrangement of materials. Corundum-bearing belts of the gneisses and mica-schists, which sometimes pass into quartz-schists, have no apparent or probable relation with the peridotites, although occurring in the same region, and in some cases near the outcrops of these rocks.

The chief localities of corundum-bearing peridotite are in Clay, Macon and Jackson counties, in the southwestern corner of the State, and most of the corundum-bearing gneisses, etc., are also found in the same counties. Certain scattered occurrences of corundum in amphibolite dikes and also in the gneisses are found east of the mountains, particularly in Iredell county.

"Other occurrences of corundum in America" extends the list of corundum-bearing igneous rocks to include granite, syenite, nepheline-syenite, plumasite, norite, andesite, and monchiquite, and adds crystalline limestone to the list of metamorphic corundum-bearing rocks. A brief description

of each of these modes of occurrences is given with references to the literature of those that have been previously described. An additional list of "Modes of occurrence of corundum not found in America" adds to the number of corundum-bearing igneous rocks, kyschtmite, tonalate, gabbro, quartz-porphyry, trachyte, and basalt, besides contact-zones and inclusions in igneous rocks. To the metamorphic list are added corundum-schists and porphyroids and graphite. These are followed in turn by brief descriptions, completing the list to date of all known modes occurrence of corundum throughout the world.

The distribution of corundum is described in Chapter VIII. Like the peridotites, this is treated first with reference to the Appalachian belt as a whole, noting the occurrences in Alabama, Georgia, South Carolina, North Carolina, Pennsylvania, New Jersey, Connecticut and Massachusetts. Corundum in the western part of the country includes descriptions of occurrences thus far known in Montana, Colorado and California. This is followed by a description of the North Carolina localities in detail, arranged by counties, beginning in the southwestern corner of the State. The chapter closes with the description of foreign corundum and emery deposits, including those of Canada, India, Turkey, and the Grecian Archipelago.

Chapter IX deals with the alteration of corundum and its associated minerals in great detail. The list of minerals found associated with corundum in North Carolina includes 62 species, each of which is described, with its mode of occurrence, and its relations to the occurrence of corundum. Many have chemical analyses and crystallographic characters also given. "Minerals associated with corundum not found in North Carolina" adds 12 more to this list, from various American and foreign localities.

The difficult question of the origin of corundum is discussed in Chapter X. This is prefaced by an account of the artificial production of corundum, and the origin of corundum in nature

is introduced by a sketch of the various hypotheses that have been proposed during the last quarter of a century. After a discussion of the field relations and the later experiments in the production of artificial corundum, the conclusion is reached that the corundum was held in solution in the molten magma of the peridotite when it was intruded into the country rocks, and that it separated out among the first minerals segregated as the mass began to cool. The conclusion is also reached that the corundum in the quartz-schists and gneisses is the result of metamorphism of sandstones and shales, some of which were rich in alumina, perhaps in the form of bauxite, which, during metamorphism, crystallized out as corundum.

Chapter XI deals with corundum mining and milling. It is introduced by a historical sketch of corundum mining in the East, followed by a sketch of mining in America. "Suggestions to prospectors" and methods of mining and milling as carried out at various plants, conclude the chapter.

Chapter XII discusses the chromite and other economic minerals of the corundum-peridotite belt. Chromite in promising quantities has been found at a number of the peridotite localities in western North Carolina, particularly in Jackson and Yancey counties. Its origin and relations are discussed and the conclusion reached is essentially the same as for the origin of corundum in peridotites. A discussion of the chemical composition of chromite and its uses, and a description of the chromite locolities of the region, with a summary of occurrences in other parts of the world, follow. The distribution and character of asbestos, nickel ores, serpentine, and limonite, minerals which, thus far, are of minor importance in the region, close the chapter.

An appendix, consisting of a bibliography of American peridotites, and corundum and associated minerals, is not complete, perhaps, as regards the whole of North America, but is believed to be practically complete for North Carolina

and the eastern crystalline region in general. There are also many references to foreign literature in foot-notes throughout the work, and the volume is closed with an elaborate index.

Copies of this volume may be had by addressing the North Carolina Geological Survey, Chapel Hill, N. C.

NOTES ON THE GEOLOGY OF CURRITUCK BANKS.

BY COLLIER COBB.

During the past summer (August, 1904) I have made a careful examination of the Currituck Banks from the Virginia line to Kittyhawk Bay and the Kill Devil Hills, studying also the adjoining islands and mainland to the west.

On Knotts Island the Columbia sands form a thin covering from one to three feet in thickness, resting upon clays of Neocene age, not more than ten to twelve feet thick, at several points where I bored with a soil auger. Beneath these clays are the Tertiary shell marls so well known over eastern North Carolina. This shell-rock, as it is called here, occurs at a number of points in Currituck Sound, as I found by sailing pretty well over the entire sound. A somewhat extensive area of this deposit lies near the surface of the water between Church's Island and the Currituck Bank, being about half a mile west of the Whalehead Life Saving Station.

The cruise in the Sound revealed well-marked channels ending against The Banks at the sites of Old Currituck Inlet, New Currituck Inlet, Caffey's Inlet, and the old inlet opposite Colleton Island. The sand-reefs or banks along the North Carolina coast have grown steadily in length from the time of the earliest settlements, until there is now no inlet from Cape Henry to Oregon Inlet. The inlets through the Currituck Banks have been closed up by the steady southward march of the great barchanes or medanos, crescentic sand-dunes, known locally as whaleheads. These dunes are composed of singularly homogeneous blownsands, the horns or cusps of the barchanes pointing to lee-ward, which is almost due South.

Following the ocean side of Currituck Banks, one may often see a distinct terrace marking the line between the Columbia sands and the Neocene clays; on stormy days comminuted Tertiary shells are washed up; and quite frequently after a storm one may pick up water-worn shells of *Cardium*, *Anomia*, and *Exogyra*, of which I brought away a score of specimens. These are distinctly Cretaceous forms. *Ostrea* is unknown among these deposits, but oyster shell heaps of recent date are common on the sound side near the southern end of Currituck.

The facts go to show that The Banks are not of such recent origin as is usually supposed, but are of the same age geologicaly as the adjacent mainland.

On the Atlantic side of this Currituck Bank I found numerous pebbles, some as n uch as three to four inches in diameter, buried in the upper sands and muds, some well rounded, others sub-angular, and some of these latter even striated. I have collections of exactly similar stones from the beaches of the North Shore of Massachusetts, from Aquidneck Island, and from Martha's Vineyard. There are, however, in my collection from this Currituck beach many fragments of Triassic trap and sandstone, which are not known among the beach pebbles of the other localities.

These pebbles are, almost without exception, unlike any of the stone of the mainland of North Carolina; and both their position and individual characters point to their glacial origin. It is clear that they are the work of the ice sheet of the last glacial period, drifted southward by icebergs which stranded on the Carolina coast. A rather rapid subsidence of the coast is now in progress, the blown sands and the silt, arrested by aquatic vegetation are rapidly filling in the sound side of the Banks, and the water of the Currituck Sound has already become fresh since it has been cut off from direct communication with the sea, the inflowing streams having leached out the salt.

The Great Whaleshead barchane opposite Church's Island

has moved southward three quarters of a mile in twenty years, and the closing up of the sound has been so rapid as to bring about litigation in the courts for the possession of the new made land. The subsidence of the land is so easily seen from beacons and telegraph poles as to be a matter of remark among the least observant of the inhabitants.

Presented October 11, 1904.

THE NEW ORLEANS MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND THE AMERICAN CHEMICAL SOCIETY.

BY CHAS. H. HERTY

One of the prime objects of the American Association for the Advancement of Science is, as formulated in its Constitution, "by periodical and migratory meetings, to promote intercourse between those who are cultivating science in different parts of America." Following this policy the 35th meeting of the Association was held during Convocation week, Dec. 29th, '05–Jan. 4th, '06 at New Orleans, La., this being the first meeting held in that section of the country. The fact that many of the affiliated societies met at the same time at other points reduced largely the attendance at the New Orleans Meeting, but the joint sessions of Section C (chemistry) and the American Chemical Society resulted in a full program and a large attendance of chemists. The buildings of Tulane University were placed at the disposal of the Association, the meetings of Section C and the American Chemical Society being held in the chemical laboratory. The sessions of the American Chemical Society were presided over by President F. P. Venable of the University of North Carolina, while Dr. L. P. Kinnicutt of Worcester, Mass. officiated in the sessions of Section C.

In his address as retiring president of the American Chemical Society President Venable presented an interesting historical account of the early days of chemical research in this country, the development of chemical societies and the publication of journals intended primarily for the stimulation of

research among American chemists. The address closed with an appeal for more earnest prosecution of research, especially by those connected with educational institutions.

"The Sanitary Value of a Water Analysis" was discussed by Prof. Kinnicutt the presiding officer of Section C. His wide experience in this important field gave added weight and interest to the conclusions he drew and to the standards he recommend.

It is difficult to make selections from the long list of papers presented. Some however were more general in their character than others and aid thus in such a selection.

The many sided claims of Agricultural Chemistry upon all branches of Chemistry were ably set forth in a paper by Dr. H. W. Wiley of the U. S. Bureau of Chemistry, while Dr. W. L. Dudley of Vanderbilt University discussed "Laboratory Designing and Construction," a subject in which all were interested and on which each chemist had his own views; but from the paper and the discussion which followed valuable ideas were gained for guidance in future laboratory construction.

Perhaps the most interesting paper, recording the results of careful research in the laboratory, was that on "Recent Experimental Researches on Osmosis" by Prot. Louis Kahlenberg of the University of Wisconsin. This work, to be published immediately, promises to be revolutionary. Prof. Kahlenberg found in ordinary rubber dam, such as used by dentists, a semi-permeable membrane which, unlike those used in former experiments on osmosis was permeable to colloids but impermeable to crystalloids. The accidental discovery of the great change in osmotic pressure on stirring the liquid lying next to the membrane throws great uncertainty on all results recorded hitherto on this subject.

Prof. W, D. Bancroft of Cornell University presented an interesting paper in which was offered a probable explanation of the marked difference in behavior of electrolytes in very dilute and in concentrated solutions.

A number of valuable papers were read by representatives of the U. S. Bureau of Sails. While far from complete it seems reasonable to hope that the work now being conducted by this Bureau will yet throw valuable light upon the whole subject of artificial fertilization of soils.

Hearty endorsement was given both by the American Chemical Society and by Section C to the efforts of the Committee of Manufacturers "in urging the passage of an act through Congress providing for the sale of tax-free alcohol under proper restriction." The inability at present to secure such tax-free alcohol is most largely responsible for the fact that many of our manufacturers of chemical products can not compete successfully with the manufacturers of "Germany, France and England where the laws permit the sale of tax-free alcohol for use in the arts and industries.

This short sketch will not permit of more detailed discussion of the program, but no account of a meeting of chemists would be complete without some word about the excursions which constitute such pleasant additions to the program, affording the members opportunity for inspecting chemical operations on a commercial scale and at the same time easy means for getting into closer personal touch with each other. The chief object of interest at New Orleans was the Sugar Experiment Station at which was exhibited every stage of the sugar industry from the cutting of the cane in the fields to the barrelling of the pure white sugar. The quaint character of the old French Quarter of New Orleans interested all.

THE CEMENT GOLD ORES OF DEADWOOD, BLACK HILLS, SOUTH DAKOTA.

BY JOSEPH HYDE PRATT.

The ore deposits of the Black Hills that are known as the "Cement Gold Ores" or "Fossil Placer" are to a certain extent peculiar to this general section of South Dakota and are in reality old auriferous placer deposits whose constituent sands and pebbles have become tightly cemented together with silica and iron oxide, forming such a hard, compact rock that now as they break the line of fracture is just as apt to pass through the pebbles of the conglomerate as the cementing material. The conglomerates of which the cement gold ores are a part are found over quite an extensive area as the basal portion of the Cambrian strata, but in most of the areas where they have been observed, they are but a few feet in thickness and carry little or no gold. There are two areas, one in the vicinity of Spearfish Canyon and the other in the vicinity of Lead, about 3 miles west of Deadwood, where the conglomerate reaches a thickness of from 20 to 40 feet. It is the latter locality, however, where the conglomerates are auriferous.

These conglomerates in the vicinity of Lead, Lawrence County, designated as the "Deadwood Cement Gold Ores" have been found over an area but a few miles in length and one mile in width which is exposed as isolated areas extending from just south of the city of Lead in a northerly direction across Bobtail Gulch, Sawpit Gulch, through the small town of Central and across Blacktail Gulch, making a total distance of something over 2 miles in this direction. They

are exposed on each side of this line at intervals so that the total width is about one mile. These conglomerates throughout this area vary considerably in thickness and, although they are all auriferous, they vary widely in the value of their gold contents and it is only in a comparatively small portion of this area that they are of economic importance. The most extensive mining has been done on the slopes of the mountains rising on both sides of Blacktail Gulch in what is known as the Whitewood Mining District. These cement gold ores rest unconformably on the old Algonkian schists and slates which are tilted at very steep angles and they have been derived from the destruction and the erosion of the auriferous quartz seams and veins that these schists contained. In the erosion of these schists there has been left a very uneven surface with ridges and shallow depressions that have been subsequently covered with gravels, which have produced the placer deposits. These are lying conformably with the sandstone and quartzite above. These latter rocks are capped by a flow of porphyritic rock in some cases a phonolite, which was the last rock formed and was intruded through the schists, conglomerate and quartzite as dikes, chimneys and laccolites.

The history of these rocks would read something as follows: The old Algonkian schists and slates which contained the auriferous seams and veins of quartz, were subjected to constant erosion during the early Silurian period, yielding sands, gravels, etc., which in time formed the conglomerate, sandstones, imposed thereon, which are a part of the Cambrian. During the formation of the Cambrian rocks the Algonkian rocks of this section were not submerged, although the Algonkian land was slowly subsiding. These gravels or conglomerates have been partially formed by the action of shallow seas, but they are also the result of erosion by streams and rivers, in the same manner as ordinary placer deposits that are now being worked by hydraulic methods were formed. In many cases the old water courses can be

distinctly traced, as they are exposed in mining the conglomerates. These Algonkian rocks were exposed as a rugged island with perhaps the highest point toward Harney Peak to the south, and in this direction the present cement beds have a tendency to become thinner. This whole Algonkian area was finally submerged and when it was raised again above the surface, the overlying rocks were not disturbed or tilted to any considerable extent. Later the schists, conglomerates and sandstones were cut by intrusions of quartz-porphyry and phonolite, partly in the form of dikes and as laccolite or sheet flows, so that at the present time the rocks are capped by the eruptives. These intrusions have metamorphosed, somewhat, the conglomerates and sandstones, partially converting them into quartzite-conglomerate and quartzite. These intrusive flows also penetrated laterally into the rocks forming thin sheets, varying from a few inches to several feet in thickness.

While the different strata of sandstones and conglomerates are lying conformably with each other, the lower stratum of conglomerate is lying unconformobly upon the Algonkian slates and schists.

While all of these cement ores carry gold values to some extent, they are found to be richer in someportions than in others. There are deep channels between rims of the schist which carry the greater amount of gold, and as the conglomerate is mined toward these rims it becomes thinner and thinner with diminishing values. These ancient channels were the natural lines of concentration.

These sedimentary and metamorphosed rocks have a general northerly course and are dipping in the same direction at a very flat angle (about 12 degrees), while the schists are dipping easterly at very steep angles. At the Homestake mine the small amount of cement or conglomerate ore that was encountered was near the summit of the hill in which are the immense open cuts of this mine. The conglomerate at the Homestake was thin, but becomes thicker toward Blacktail Gulch to the north and at the Phoenix and Jupiter mines

it is as much as 40 feet thick and 700 feet below the summit of the ridge. The thickness of these conglomerates rises from a few feet where they are just above some of the rims of the schists to about 40 feet, measured from the lowest point in the channel to Bessie Gulch. It is the few lower feet that are carrying most of the values, and that in direct contact with the schist, which would correspond in an ordenary placer deposit to the gravel resting on bed rock, contains most of the gold. It is therefore essential in mining these cement or conglomerate ores to clean up carefully all the fines and gravel resting on the schist and a few inches of the schist itself. Then again, the better values will be apt to be found in the troughs and depressions of the schist rock and have a tendency to become less and less toward the rims of the troughs or channels. Also any slight protuberance in the schist which may rise even but an inch or two above the general level, will have acted as ripples and thus have retarded the fall of the gold.

There has been some deposition of sulphides carrying gold in these conglomerates after their formation; but the larger portion of the gold is the free gold that was deposited in the original placer deposits.

It is essential in estimating the value of deposits of this character to determine to what distance from the enriched portions or channels and what thickness this material can be mined and milled as a profit. Thus to satisfactorily sample this ore, it must be so opened up that it can be done from and including a portion of the bed rock upwards for a distance of at least 5 feet as this thickness of material must be removed in ordinary mining.

Another possibility in connection with the mining of these cement ores is that of encountering workable deposits of the gold-bearing schist, The general strike of the band of auriferous schist, upon which is located the Homestake mine would indicate that it would pass about ½ mile to the northwest of the main deposits of cement ores; but the strike of the

auriferous schists encountered in the Caledonia mine is N. 15° W. and its extension would pass almost directly under the conglomerate of Blacktail Gulch. In only a few instances have the underlying schists of these cement ore mines been tested, but in a number of cases where this has been done, fair values have been obtained. In testing the schists care must be taken to reach a sufficient depth before sampling so as to be beyond the influence of the gold that may have penetrated into the schist from the placer deposits.

It has been estimated that $1,500,000 has been taken from these conglomerate or cement ores in the early mining; and in the aggregate there is still a larger value in these deposits.